ACTIVITIES

1. Planetary Mnemonic

You are probably familiar with the Mnemonic “My Very Energetic Monkey Jumps Swiftly Under Night Poles” to remember the planets in the solar system. What about this one:

"My Antic Attempts To Irritate Everyone Got Caught"

Jupiter has 16 known moons, all of which are named for other figures in the mythology of Jupiter. In order of increasing distance from Jupiter, they are:

Jupiter and the Galilean Moons

Adrastea, Amalthea, Thebe, Io, Europa, Ganymede, Callisto, Leda, Himalia, Lysithea, Elara Ananke, Carme, Pasiphae, Sinope

Problem is, it's hard to remember all those names!

Come up with a simple mnemonic that will help people remember the order of Jupiter's moons--at least out to Callisto, the Galilean satellite furthest from Jupiter. The first sentence of this exercise is one attempt. How about: "Mercy! At Aunt's Table, I Eat Good Cheese?

Can you come up with something that is easy to remember? Can you turn any other the other moon systems of a planet into a Mnemonic.

These are some of the winners of the Online from Jupiter Competition held in 1997.

Teresa Morelli, Grade 6, Holy Family Middle School:
Many Animals Are Tempted Into Eating Grilled Chocolate Ladybug Hamburgers Loaded Enormously Alongside Chopped Potato Sauce.

Christine Sulc, Grade 2, Island Park Elementary, Mercer Island, WA:
My Aunt Anna Talked In Excitement, "Gee, Cool."

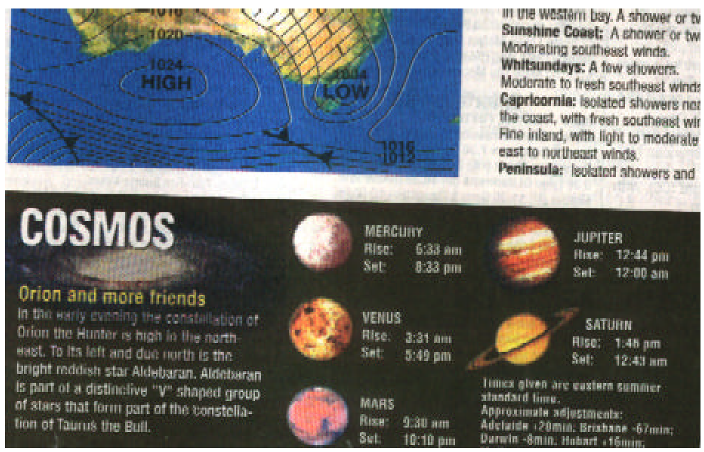
Jason Dooney, St. Catherine of Siena School, llorsham, PA:
My ant ate the incredible edible giant cow.

Markland Fridae, Grade 3, Waggoner Elementary School, Winters, CA:
Many Ants Are Tickling Irritatingly; Everyone's Going crazy!
Look How Large Enemy Ants Carry Picnic Supplies!

Once you’ve mastered Jupiter’s moons, try Saturn, Uranus and Neptune!

2. Rising and setting time of planets

The Canberra Times (and other daily newspapers) print the rising and setting times of the planets every day. Before your visit, get the students to look up the rising and setting times of the planets. Get the kids to check the times on the day of the visit, or for as long as you like before and or after your visit (we suggest from one to two weeks on either side of your visit). While they're in the visitor centre students will use our Orrery (model of the solar system) to note the relative positions of one or two planets.



Planet times from the newspaper

NOTE: See also "Observing a Planet" activity.

3. Observing a Planet

What's This Activity About?

One of the most common questions about astronomy is, "How do you know that 'star' is really a planet, and not a star? It looks just like a star." Without a telescope, it can seem impossible to someone unfamiliar with the constellations to tell the planets from the background stars. This simple activity shows how to tell the difference between stars and planets in our sky. Like other PASS activities, this was designed to be used with a planetarium. However, the concept of observing the sky over a period of time to identify "wanderers' is very important, and this activity can be done successfully in a classroom.

What Will Student's Do?

Students observe a series of constellation maps on a blackboard or overhead projector and identify the "wandering star." Then they complete the activity by going outside to simulate the motion of planets around the Sun in front of more distant background stars.

Tips and Suggestions

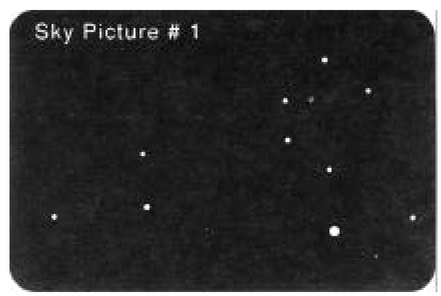
Use a monthly sky chart from astronomy magazines such as Sky & Telescope, or annual calendars such as Astronomy 2000 to match this activity to your local sky during a particular season. If bright planets like Venus or Jupiter are visible around sunset, you can ask older students to make pictures of what they see over two to three weeks.

Investigate where or when particular planets are seen (Venus and Mercury are always seen around sunrise or sunset, while Mars, Jupiter and Saturn can be seen throughout the night). Why do we see some planets and not see others? Relate this activity to the history of astronomy in various cultures (the Greek celestial models, Ptolemy, the Mayan calendars based on Venus, the observations of Tycho Brahe).

Observing a Planet

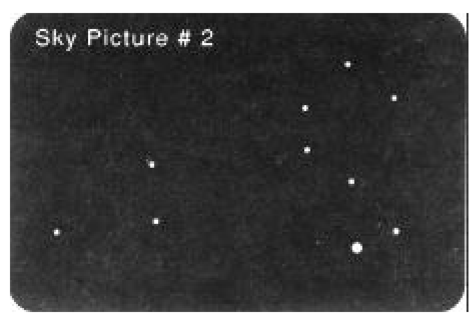
Stars and planets both look like points of light in the night-time sky. Stars are huge hot balls of gas like the Sun. Planets are cooler balls of material like the Earth. Planets circle around stars in "orbits" and are almost always much smaller than stars. It takes the Earth one full year to complete its orbit around the Sun.

Here is a picture of the planet Saturn among the stars. Which one of these points of light do you think is Saturn?



Direct students' attention to sky picture #1, and invite them to guess which dot is Saturn. Most students will guess the bright dot

Hide picture # 1 and show picture #2.

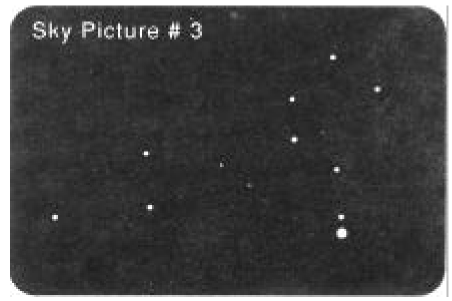


Here is another picture made one month later, showing the same part of the sky. Can you see anything different about it? Would you like to take a second guess about which one of these points of light is Saturn? Let's compare with last months picture side by side.

Expose pictures #1 and #2 side by side.

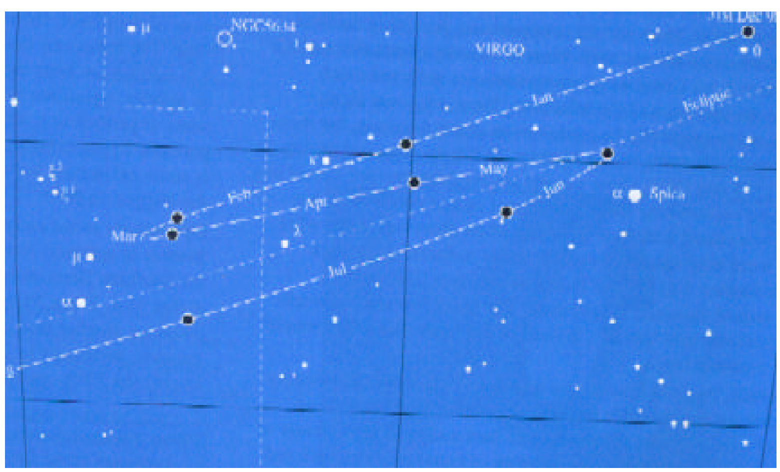
Where do you PREDICT Saturn will appear one month later? Allow time for students to answer your question.

Expose picture #3.



Here is how this pattern of stars appeared one month later. Who would like to describe how Saturn "wanders" against the background stars?

The planets appear to wander at different speeds and in different directions from month-to-month. Teachers who would like to learn more about these motions are encouraged to consult a 'sky calendar' article in one of the many astronomy periodicals.



Planet finder map from Astronomy 1999

4. Design a mission to a planet.

There are strictly no correct or incorrect answers, however there are limitations to what a spacecraft can do when exploring each planet. The Galileo and Cassini websites provide information on the components of spacecraft and what they do. Once again it may be a good idea to combine the students answers on the board. The name of the spacecraft should reflect the mission and planet targeted (eg. Galileo is exploring the Jovian moons first seen by Galileo). Below is a list

Planet	Type of Spacecraft	Studying	Name
Mercury	Lander Orbiter	Soil Analysis Solar Radiation Mineral sensing	Hermes Solar Explorer Wind
Venus	Lander Orbiter Probe	Atmosphere Rocks and Soil	Cupid CO_2 sampler
Moon	All four	Soil Solar Radiation Mineral Sensing The Earth Astronomy	Luna C
Mars	All four	Lack of Ozone Layer	War bird Water Diviner Red Rover
Jupiter	Probe Orbiter	Atmospheric Studies Ring Systems Moons Radiation Fields	Jova Jupiter Moon Hopper

5. How long would it take you to walk/drive/fly through the solar system?

Since distances to planets are very difficult to imagine, you could help to illustrate the scale of the solar system by getting the class to work out how long it would take them to reach the moon, the planets and the sun, travelling at different speeds. This is an effective way of illustrating the distances between objects in the solar system, without having to tackle actual physical distance measurements which are next to impossible for anyone to effectively visualise.

Before you begin you could lead a discussion where the class estimates (best-guesses) how long it would take them to travel to certain places in the solar system. Estimates can be collated and displayed before the actual calculations are carried out. The calculated answers could then be compared with the estimates. Students could also add the times taken for a modern rocket to travel to the various locations, measured in years, months, and days etc. Estimated answers to solar system objects are found in the chart below.

The following standards were used for calculating travel times:

Walking: (3.6 km/h) Driving: (80 km/h) Flying in a Jet: (1436 km/h)

Planetary Body	Ave Distance from Earth (km)	Walking (Years)	Driving (Years)	Flying a Jet (Years)
Sun	150,000,000	4753	213	12
Moon	384,000	11	0.6	0.03
Mercury	92,000,000	2588	133	7
Venus	41,000,000	1175	61	3
Mars	78,000,000	2222	113	6
Jupiter	629,000,000	17843	909	46
Saturn	1,227,000,000	36421	1848	92
Uranus	2,721,000,000	76894	3935	194
Neptune	4,347,000,000	123579	6289	313
Pluto	5,750,000,000	162622	8738	410

Depending on the mathematics level of the class, varying degrees of accuracy can be calculated. For example, for a simpler method use the following guide:

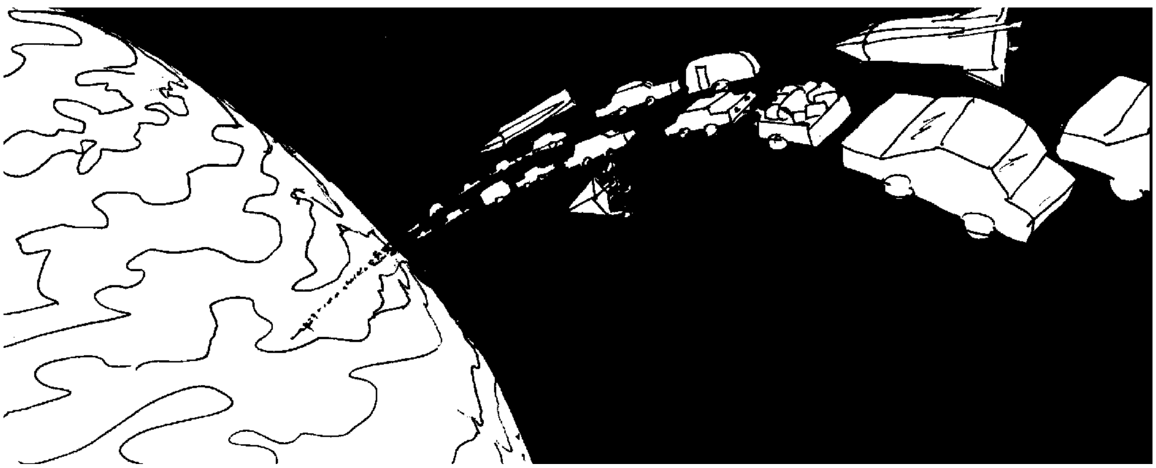
Hours = Distance / 40,000 (to nearest hour)

Days = Hours / 24 (to nearest day)

Months = Days / 30 (to nearest month)

Years = Months / 12

Students could then calculate their ages at the time of their arrival at each object.



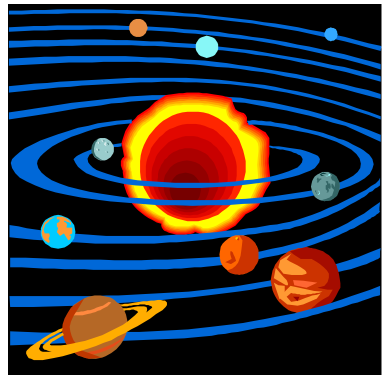
NOTE: See also: A Toilet Paper Solar System Scale Model and Scaling Down the Solar System activities attached.

6. MODELS OF THE SOLAR SYSTEM

NOTE TO TEACHERS: The notion of scale, especially when dealing with such enormous distances as those that are characteristic of the solar system, is a difficult one to convey. Typically the problem is this: Scaling the distances between planets, or scaling the relative sizes of the planets is not terribly difficult to do. However, what is difficult (on a small enough scale!) is to scale both size and distance simultaneously. If the distance is scaled down to a manageable size, the planets themselves cannot be appropriately scaled. Conversely, scaling the planets' relative sizes in a reasonable way, means that the distances between the planets are too large to scale for a classroom! You'll get a sense of this awkwardness if you combine activities 6A and 6B. Having said that, the activity in this section that helps to convey the distances in a more meaningful way to students is Activity 5 above, "How long would it take to walk/drive/ fly through the solar system?" We suggest using this activity in conjunction with any of the solar system scale models to approach the issue in two conceptually distinct ways.

It is also important to note here that although the activities in this set result in placing all of the planets in a row, this is just for ease of comparison. Of course the planets are not always (in fact very very rarely) lined up in a row. The Orrery in the visitor centre shows the relative positions of the planets in their orbits around the Sun, for that particular week or month.

6a) A TOILET PAPER SOLAR SYSTEM SCALE MODEL - scaling the distances between planets



MATERIALS NEEDED:

Index cards, 1 roll of toilet paper.

THE ACTIVITY.

First be sure that your students understand the concept of scale models. Ask the class why it is necessary to put things on a scale when discussing distance and size in astronomy. In this model, toilet paper represents an imaginary celestial yardstick, with each square of toilet paper representing 1.5 million (1,500,000) kilometres.

The table below gives the average (approximate) distances of the planets from the Sun. Please note that the number of squares of toilet paper listed by each planet is the distance from the Sun, not the distance from the preceding planet.

Planet	Distance from Sun
Mercury	4 sheets of TP
Venus	6 sheets of TP
Earth	10 sheets of TP
Mars	14 sheets of TP
Jupiter	48 sheets of TP
Saturn	89 sheets of TP
Uranus	178 sheets of TP
Neptune	279 sheets of TP
Pluto	368 sheets of TP

Write the names of the planets and the Sun on each card. Have groups of students count out squares of toilet paper needed to reach each planet. Select a student from each group to represent each planet, and as the model is created, have them stand at the appropriate planet location with their index card.

6b) SOLAR SYSTEM MODEL - scaling size

PART 1 - HOW BIG ARE THE PLANETS RELATIVE TO EACH OTHER?

MATERIALS (for each team of students):

Sun - *a beach ball 80 cm in diameter*

Mercury - *a mustard seed*

Venus - *a pea or small marshmallow*

Earth - *small marshmallow*

Mars - *peppercorn*

Jupiter - *small grapefruit*

Saturn - *orange or small apple*

Uranus - *large cherry tomato*

Neptune - *small cherry tomato*

Pluto - *poppy seed*

STEP BY STEP:

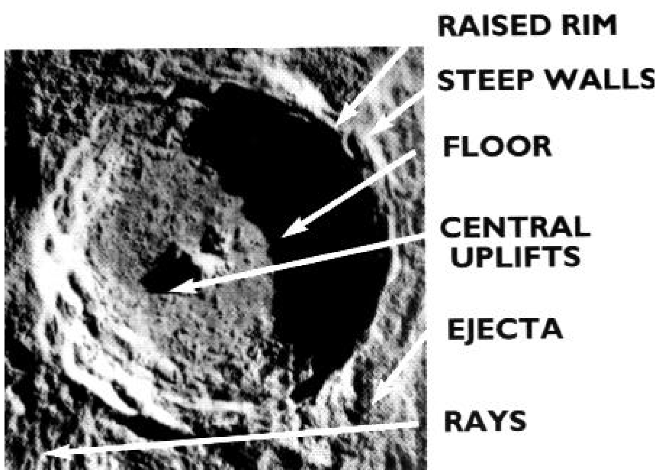
1. Collect your materials from the teacher.
2. Place the objects on your desk in the order of the planets from the Sun.

The nine planets of the solar system can be divided into two groups, the rock-like or terrestrial planets and the gas giant planets, also called Jovian planets. The rock-like planets are the inner planets-Mercury, Venus, Earth, Mars-along with distant Pluto. They are the smaller planets. The gas giant planets-Jupiter, Saturn, Uranus, and Neptune-are much larger and have no solid surface on which a spaceship could land. Jupiter is the largest planet in the solar system.

7. *Craters in the Solar System*

The Moon's landscape is very different from any landscape on Earth. The Moon is marked with about 30,000 large craters and countless small ones. Impact craters are large circular impressions made by meteoroids smashing into the surface of the Moon and exploding the materials outward.

This diagram shows typical characteristics of a lunar impact crater



Raised rim - Formed during impact, rock is thrown out of the crater and deposited nearby.
Floor - Bowl shaped or flat, usually lower than the surrounding ground level.
Rays - Streaks of rock fragments shot outward from the impact.
Central uplifts - Occurring in the center of the craters, these mountains are formed due to the rapid changes in pressure during the impact.
Walls - Usually steep, may have giant stairs called terraces.
Ejecta - A blanket of material surrounding the crater following the impact.

The greater the height of the drop, the deeper the crater, and the more spread out the ejecta. The crater formed with force is the deepest, with the ejecta evenly dispersed. The ejecta from the crater formed at an angle will extend for some distance in the direction the projectile was aimed.

Craters in the Solar System

Materials:

pie pan

metric ruler

flour

meter stick

cocoa

newspaper

small pebbles

Step by Step:

1 Cover the floor with newspaper and fill the pie pan with a layer of flour.

2. Cover the top of the flour with a light dusting of cocoa powder.
3. Place your pie pan on the newspaper and place your meter stick on the floor by the pan.
4. Drop a pebble into the pan from a height of 30 cm.
5. Measure the diameter and the depth of the crater, using your ruler. Record the information on your Data Collection Chart.
6. Remove the pebble and smooth out the flour. Sprinkle another light dusting of cocoa.
7. Repeat steps 4 - 6, using heights of 50 cm and 90 cm.

CAUTION: Your teacher must supervise the next part of your experiment.

8. Drop a pebble into the pan using some force. Record your measurements.
9. Throw a pebble into the pan so that it strikes the pan at an angle. Record your resulting measurements.

DATA COLLECTION CHART

Height of Strike	Depth of Crater	Diameter of Crater	Drawing of Crater
30cm.			
50cm			
90 cm			
With Force			
Angle			

Drawing Conclusions:

Describe how the craters were different when pebbles were dropped from different heights.

Describe why the craters in steps 8 and 9 were different from the rest.

8. Chromatography

Chromatography, from the Greek word for "colour writing," is a method of separating a mixture of compounds by the use of a porous material. In paper chromatography, a mixture of compounds is dissolved in a suitable solvent, and drops of the mixture are put on a strip of paper. The paper is suspended in a closed container with the paper dipping into the solvent. The solvent rises up the paper and will travel farthest, while the compounds from the mixture will rise to different heights, thus separating the different compounds for analysis.

Water-soluble inks may appear to be a single colour but they are usually mixtures of different pigments. In this experiment, the movement of the solvent and the pigments are caused by capillary action. The reason that the different colours separate is that the different pigments have different solubility, polarity, or molecular weight. Also, you will get different results if you use a solvent other than water or if you use absorbent paper towels instead of filter paper.

Chromatography is used in many scientific experiments in chemistry and biology. This technique for analysing substances was invented by a Russian botanist in 1903. In the 1930s and 40s, German scientists began to refine the process and developed new methods emphasising sensitivity, accuracy, and speed of the process. Astronomers use chromatography to analyse the colour emitted or reflected by stars and planets to determine the chemicals within them. For example, the planet Neptune is a deep blue colour because of the methane within its atmosphere which absorbs red and yellow light, therefore only allowing blue to reflect back.

Chromatography

Materials (for each team of 4):

Water

filter paper or coffee filter

scissors

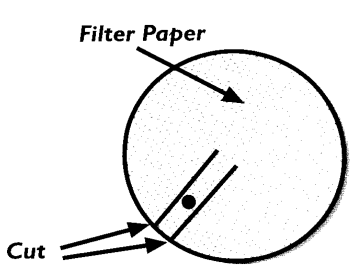
clear plastic glass or small jar

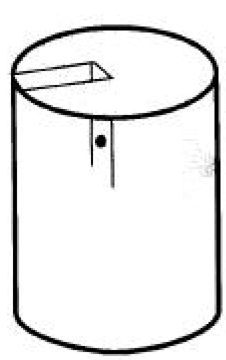
ruler

black or brown water-soluble marker

rubbing alcohol

Step by Step:





1. With the scissors, cut out a circle of filter paper LARGER than the top of the cup or jar.
2. Make two parallel cuts, 1 cm apart, from the edge to the center of the filter paper
3. Fold this cut strip down to hang into the center of the container.
4. With the marker make a heavy dot 2 cm up from the bottom of the cut strip.
5. Fill the container with water so that the hanging strip touches the water but the dot is above the water level.
6. Observe what happens when the water rises up the paper.
7. Continue to observe for 15 to 20 minutes.

Questions and Conclusion:

1. What happens when the water in the filter paper reaches the ink dot?

2. List the order of colours that you observe on the filter paper from bottom to top (that is, from the ink dot upward).

3. If different colored ink markers were used, what do you think would happen?

4. If you used hot water instead of cold, do you think the rate of the experiment would change? What change might occur?

5. Repeat the experiment using as the solvent 1/2 water and 1/2 rubbing alcohol. Do you observe a change in the pattern of colours on the filter paper?

Compare these results with the water solvent experiment. Suggest some reasons for these results.